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SUPPORTS FOR VINES

BY FREDERIC T. BIOLETTI

Vines cannot be grown economically without some form of support. With some varieties and some forms of pruning it is possible to obtain fair results without even the ordinary grape stakes, but the cost in extra labor, deferred bearing, and imperfect vines is greater than that of suitable staking or trellising and requires exceptional skill and experience.

The supports needed are of two kinds, temporary and permanent. The temporary supports make it possible to obtain quickly and economically a well-formed, sound trunk, free from irregularities which interfere with cultivation and harvesting, and from defects and wounds which diminish the vigor and the longevity of the vine. These supports are needed only until the vine is large and stout enough to support itself or to be supported by a permanent trellis, a period of from three to six years, according to the form of pruning adopted, and to the rapidity of development of the vine.

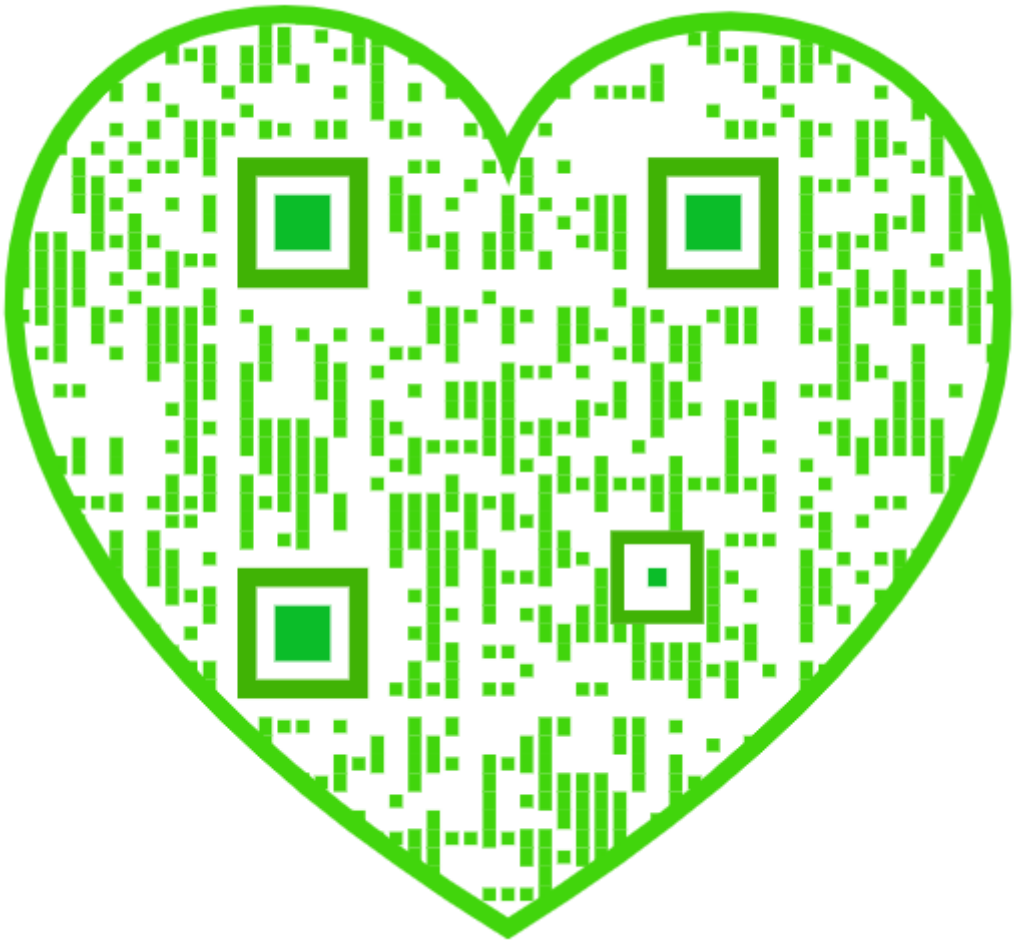
METHODS RECOMMENDED

Some of the methods in common use are inefficient or unnecessarily expensive. The methods described here have been thoroughly tested, are suited to nearly all the varieties and conditions of the grape-growing districts in California, and accomplish the objects sought with less expense than any other method tried or widely used.

HEAD-PRUNED VINES*

Method 1.—Head-pruned vines require only temporary supports. When they have developed a stout, straight trunk two or three inches in diameter, they are self-supporting. The higher the head, the thicker the trunk must be before the artificial supports can be safely removed,

* See Circular 245.



and the less vigorous the variety and the less favorable the soil and the climate, the longer is the support needed. Under the most favorable conditions the picket or stake may be removed at the end of two years, but usually the support is needed for three or four years. Vines grafted on resistant stock may not become sufficiently stout even in more than six years.

For this method a sawn redwood picket, 36 to 40 inches long and 1″ × 1″ thick, is required at each vine. This picket is driven eight or ten inches into the ground as close to the vine as is possible without injury to the roots. To prevent being blown over by the wind, it is stapled with a ¾-inch fencing staple to a No. 12 or No. 13 galvanized iron smooth fencing wire at about 24 inches from the ground. This wire is stretched between two redwood grape stakes, 4′ × 2″ × 2″, one at each end of a row. If the row is more than 200 feet long, one or more intermediate stakes should be used. These stakes are first driven 20 to 22 inches into the ground, and the wire strung. The pickets are then driven on the *windward* side of the wire and stapled.

This method of staking is shown is figure 1. It is the most economical effective method. Where the vines develop rapidly, so that they become self-supporting in two to three years, pine or other wood may be used instead of redwood.

*Method 2.**—An objection to the first method is that it prevents cross-cultivation until the wire and pickets are removed. This is serious only where Morning Glory, Bermuda Grass, or other bad weeds are prevalent. For such cases it may be necessary to adopt method 2.

For this method, a grape stake, 2″ × 2″ and from 3 to 5 feet long, is required for each vine. The shorter stakes may be a little thinner but in no case less than 1½″ × 1½″. The stake is driven close to the vine on the *leeward* side. The shorter stakes are driven 12 to 15 inches into the ground, the longer 15 to 18 inches, according to the firmness of the soil.

As no wire is used in method 2 a line should be stretched along the row to insure the exact alinement of the stakes. Special precautions should be taken to have every stake as nearly vertical as possible.

A very convenient method of staking is shown in figure 3. Two men and a low wagon with a flat bed are needed. The wagon is to carry the stakes and to serve as a stand for the man who drives them. On the wagon is placed a loose 1-inch board, about 4 feet long and 12 inches wide, with a square notch cut out of one corner. The first man drives the wagon up to the place where the stake is to be driven; the

* See Circular 245.

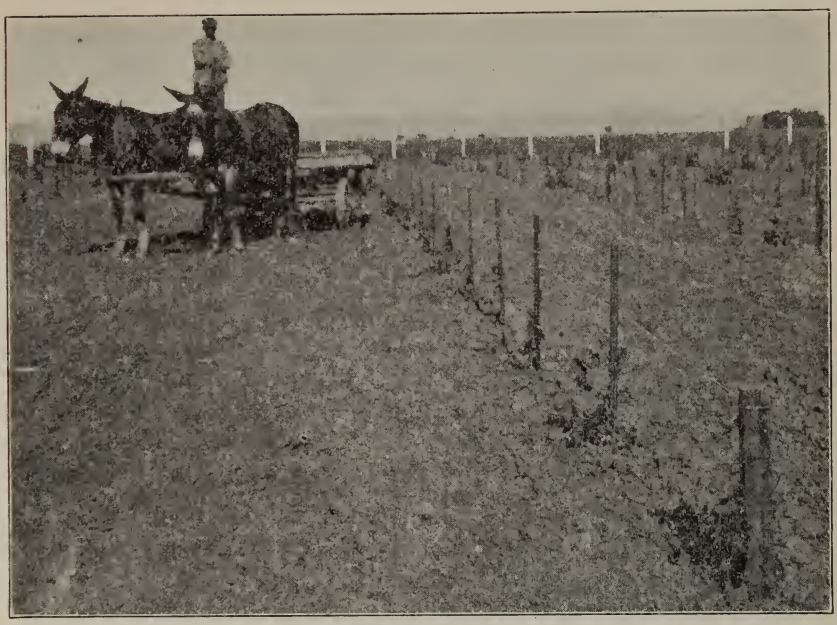


Fig. 1.—Pickets for head-pruned vines.

Fig. 2.—Five-foot stakes for head-pruned vines.

other man places the point of the stake at the proper place against the guide line, and holds it perfectly vertical. The driver then adjusts the board so that the notch comes close to the stake, stands on the board and drives the stake, while the other man presses it against the notch. This procedure insures rapid, convenient and accurate work.

Fig. 3.—Method of driving long stakes.

The possibility of accurate and rapid driving of stakes depends greatly on how they are sharpened (see fig. 4). Stakes when purchased are never properly sharpened. It is better to purchase unpointed stakes as these can be obtained more cheaply, and require no more labor to sharpen than is needed to resharpen those improperly sharpened.

As already stated, the stake should be driven as close to the vine as is possible without injury. When staking is done before planting,

the vine can be placed so that its top touches the stake. When planting is done first, it is possible to plant the vines in such a way that the stake can be driven within half an inch of the vine without danger. All that is necessary is to dig the hole and do the planting, regularly, in such a way that the vine, under the ground, slants away from the side where the stake is to be placed. (See fig. 5.) Where the vines have been planted irregularly in this respect, it is necessary to place the stakes at least two inches from the vines; even when this is done some vines may be injured.

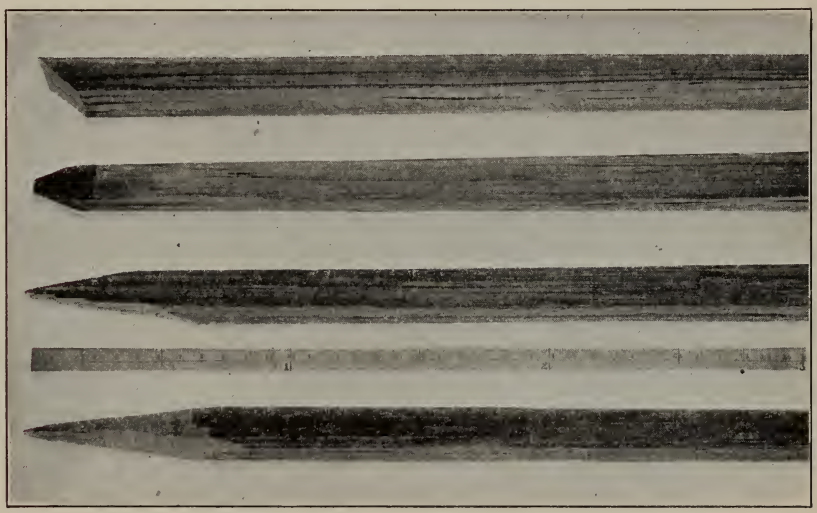


Fig. 4.—Stakes sharpened improperly (upper three) and properly (lowest one).

CANE-PRUNED VINES*

Method 3.—Besides temporary supports similar to those used for head-pruned vines, cane-pruned vines require permanent support for the annually renewed fruit canes.

The method recommended requires a 40-inch picket, $1'' \times 1''$, of sawn redwood as a temporary support for the developing trunk and two wires as a permanent support for the fruit canes. To hold these wires, a straining post at the end of each row or about 200 to 300 feet apart and a grape stake, 5′ or $6' \times 2'' \times 2''$, about every 20 to 24 feet are needed. These are permanent. With this material, a trellis similar to that shown in figure 6 is erected.

* See Circular 245.

In order to erect this trellis accurately and rapidly it should be done systematically. Certain simple tools much facilitate the work. (See fig. 10.)

The straining posts are first put in place. Lines should be drawn on the posts with a heavy carpenter's pencil to show the position of the wires and of the surface of the ground, viz., at 2 inches, 16 inches, and 44 inches from the *top* of the post. The holes are then dug with a 6-inch post-hole digger to the required depth. The posts should be

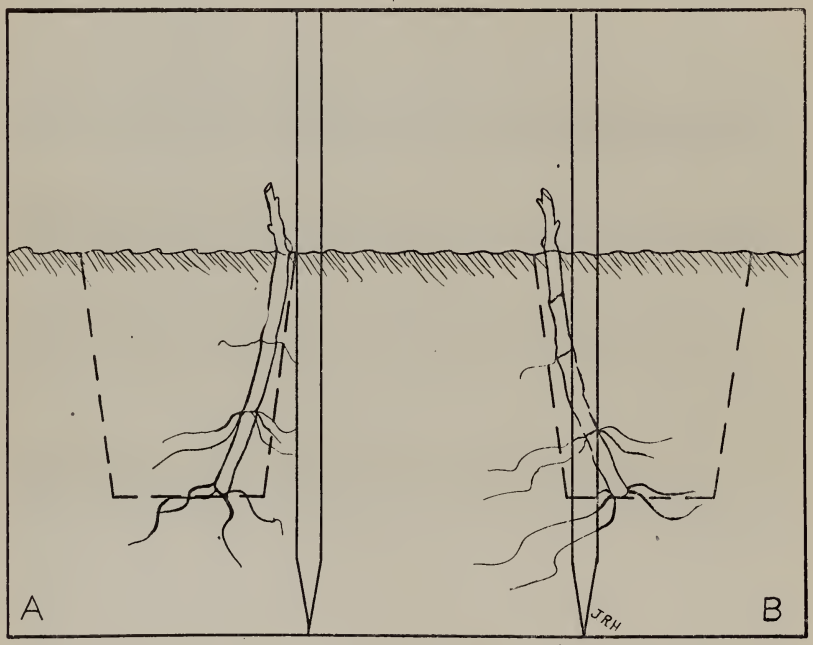


Fig. 5.—Method of planting to avoid injury in staking: A, correct; B, wrong.

canted slightly away from the row of vines—about 2 inches, or a little more in soft soil. When the wire is stretched, the pull will make them vertical. The earth should be well tamped with a tamping rod or a heavy piece of wood about $1'' \times 1\frac{1}{2}''$ and 8 to 10 feet long. No bracing is needed, though in some loose soils it is advisable to nail a piece of board $1'' \times 6''$ and 12 inches long on the inside of the post, 6 inches below the surface of the soil. The posts should be carefully centered with the row of vines. These posts are placed at about 4 feet outside of the last vine of the row. It is necessary, therefore, to allow this extra distance in planning for avenues and turning spaces.

A substitute for a straining post, which is somewhat cheaper, can be made of two 6-foot grape stakes and a piece of 1½″ × 2″ pine, 5 feet 6 inches long, braced with wire, as shown in figure 7. The material costs about 40 per cent less, but the labor a little more and the substitute is not quite so durable. Many other methods of holding the wire are in use but the two described seem the best when efficiency, cheapness, and appearance are considered. Posts of reinforced concrete have been used occasionally, but are expensive. (See fig. 14.)

When the posts are up, the lower wire should be strung. This may be a No. 12 galvanized-iron smooth fencing wire, though No. 11 is better.

Fig. 6.—Trellis for cane-pruned vines.

In stringing the wire, a reel is very convenient and time-saving. A good form used in handling telephone wires is shown in figure 8. A homemade reel of similar form is shown in figure 9.

When this form of reel is used, the wire can be laid along the row without bends or kinks and can be pulled almost tight enough by hand. No regular wire puller is needed, but a few simple tools—a wire cutter, a wire twister, and a 36-inch carpenter's wrecking bar—much facilitate the work. (See figure 10.)

The end of the wire is first passed around the post at one end of the row in a loop about 30 inches long and held by a 1½-inch staple at each side of the post. These staples should be left just loose enough to allow the wire to slip; this is for convenience in tightening the wire the following year. The method of twisting the end of the wire so that the loop will not slip is shown at the bottom of figure 11.

The wire is then drawn along the row to the other end post. A convenient method is to have the wire reel mounted on a light wagon or sled drawn by a single horse.

On reaching the other end, the wire is cut at the right length and looped around the post in exactly the same way as was done at the first end. The wire is drawn as tightly as it can be by one man, brought around the post and held with the wire cutter until the loop is finished with the wire twister. (See fig. 11.) With a little practice one man can do this without assistance. Before passing the wire

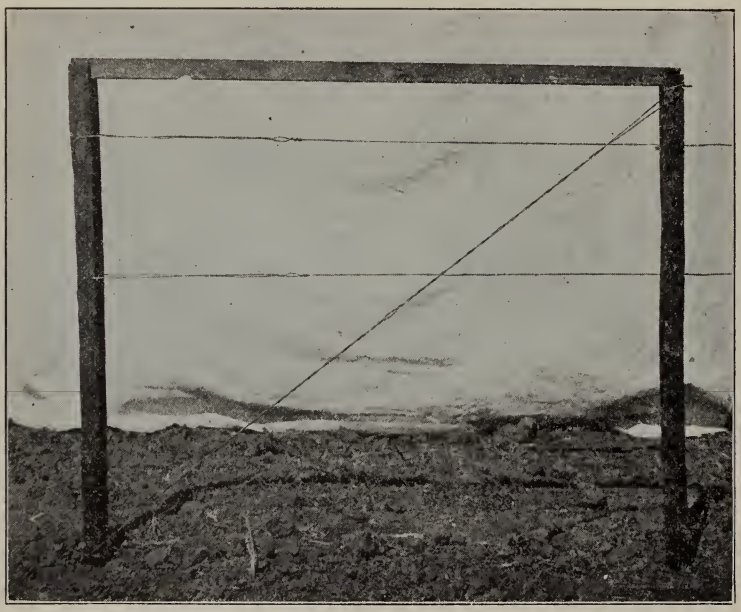


Fig. 7.—Brace made from grape stakes.

around the post, the wrecking bar is hung on top, as shown in figure 11. When the loop is complete it is placed at the proper height as indicated by the mark on the post and held by two 1½-inch staples driven nearly tight.

A wire not over 300 feet long put up in this way requires very little supplementary stretching, and this can be done with the wrecking bar as shown in figure 12. The staples are driven fairly tight while the bar holds the wire taut and the part of the loop drawn past the post is then bent down and stapled as shown at the bottom of figure 12.

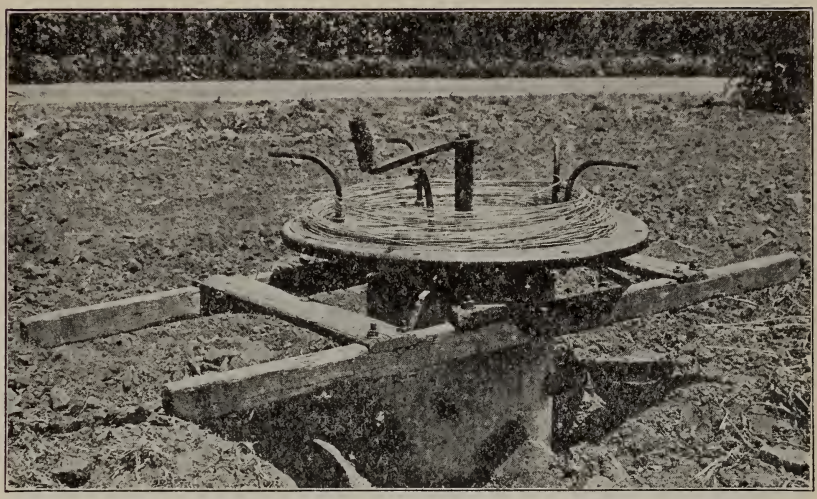


Fig. 8.—Wire reel for rapid and accurate stringing of wire.

Fig. 9.—Home-made wire reel.

The wire should not be too tight. If a wire 200 or 300 feet long is drawn by hand with sufficient force to bring the middle clear from the ground, and then pulled 6 or 8 inches with the bar, it will be sufficiently taut, especially if it has been unwound from a wire reel, and so has remained smooth. Also, stapling to the supporting grape stakes will tighten the wire considerably. (See fig. 12.)

When the first wire is up, the 5- or 6-foot supporting grape stakes should be driven. One of these should be placed at about every third vine. They should not be more than 25 feet apart and nothing is gained by having them nearer than fourteen feet. These stakes should *not* be close to a vine. It is better to place them at about 15 inches

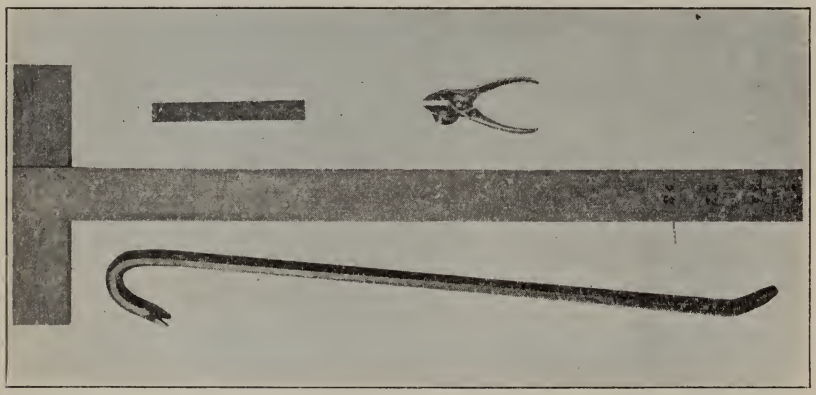


Fig. 10.—Useful trellising tools.

from a vine. (See fig. 6 and fig. 15, method 3.) These stakes are permanent and if they are placed close to a vine they will interfere with pruning, suckering, girdling, and hoeing. They are driven in the same way as the stakes in method 2 (see fig. 3), using the wire just put up as a guide to keep them exactly in line. Before driving, they should be marked with a line indicating the depth to which they are to be driven. The measurements should be made from the *top* of the stake in order that the tops will all be at the same level when in place.

The wire is then fastened to these stakes with 1½-inch staples at the height determined on. The guide shown in figure 10 is useful to insure regularity. The staples are driven not quite tight, so that the wire can run through them when being tightened.

A picket is then placed close to each vine, driven about 6 inches into the ground and fastened to the windward side of the wire with ¾-inch staples.

The upper wire is put up in exactly the same way as the lower except that it is not fastened to the pickets, which do not reach it. The placing of the second wire may be deferred to the following year, though this is inadvisable as the growth of the vines increases the time and labor required.

Fig. 11.—Method of attaching wire to post.

CORDON-PRUNED VINES*

Method 4.—Similar materials are used for this method as for method 3, i.e., 7-foot posts, 5- or 6-foot stakes, and 48-inch pickets. A vineyard where this form of trellis was put up before planting is shown in figure 13. The second wire has not been put up yet, and the pickets should be a little longer.

* See Circular 245.

In this method the arrangement of the posts and stakes differs from that in method 3. At one end of the row, the post is set near the first vine and at the other about 8 feet beyond the last vine. (See fig. 15, method 4.) The stakes are driven close to the vine instead of 15 inches away from it. The reason for this is that this position gives the best support for the horizontal trunks that extend along the lower wire in the unilateral cordon system, and as the trunks curve away from the stake there is no interference with pruning the fully formed vines.

The operations of placing the posts, wire, stakes and pickets are the same as with method 3.

VARIATIONS AND PRECAUTIONS

While the four methods described seem to be the most generally useful, they may be modified with advantage in special cases.

Height of stakes and wires.—The height of the stake necessary for head-pruned vines depends on the length of trunk required. For Muscat, a trunk 15 inches high is usually considered sufficient. This can be obtained easily with a 3-foot stake driven 12 or 15 inches into the ground. For table grapes it is advisable to have the trunk higher so that the fruit will be well off the ground, and so a 4-foot stake is needed. If a stake of this length is driven 18 inches into the ground the 30 inches left is sufficient for a trunk 24 inches high. For exceptionally large vines, such as Tokay and Malaga, especially when growing in rich soil, a 5- or 6-foot stake is preferable, making it possible to develop a trunk 3 or 3½ feet high.

An increase in the height of the vine gives some protection against spring frosts. Where these frosts are frequent it may be advisable to raise the wires for cane-pruned or cordon vine higher than the 28 inches recommended. In this case a 6-foot stake instead of a 5-foot is needed to support the wires.

Number of wires.—In the methods using two wires, the fruit canes or the cordon trunks are fastened horizontally to the lower wire. The upper wire is needed only to support the growing shoots.

There is some advantage in bending the fruit cane over the upper wire and tying it down to the lower. This procedure tends to force out more buds and to bring part of the shoots a little higher, thus making them a little safer from the frost. The tying of the canes is also a little more easily done. Where this method is used, a third wire 10 or 12 inches above the second is useful.

On the other hand, if the number of canes and their length correspond to the vigor of the vine, all the buds will start by the method recommended and safety from frost is better obtained by raising the lower wire. The saving in tying is very little and much more than

Fig. 12.—Method of tightening wire.

counterbalanced by the extra cost of disentangling the vines from the extra wire in pruning.

Time of placing supports.—Where the vines make a very large growth during the first year, as they do in fertile soil in the warmer regions, there is a great advantage in placing the stakes or trellis before the vines are planted. It is then possible in many cases to

develop a trunk and even a head during the first growing season and to obtain a paying crop at the end of the second summer. In fact, where vines make a growth the first year of several canes 8 or 10 feet long, if they are not staked until the second year, the difficulty and expense of handling them so as to give them the desired form are much increased.

In cooler regions or in soil where the vines do not make an excessive growth the first year, the staking and trellising can be deferred until the winter following planting. The only advantage gained in putting in the supports before planting in this case is greater regularity of the rows. This is, however, an important advantage in the case of trellised vines as the more exactly the vines are in line the more perfectly and economically they can be cultivated.

Preserving alignment and verticality.—The importance of exact alignment has already been pointed out. It is no less important that the trunks of the vines should be regularly vertical. If they are leaning or crooked, they interfere with cultivation and are subject to injury from tillage implements.

To insure a vertical trunk it is necessary to have the stake or picket close to the vine. This is easily accomplished if the supports are put in before planting. If the planting is done first it is important to observe the precautions already noted. (See fig. 5.) In putting up a trellis it is necessary also to be careful that the end posts are properly centered with the lines of the vines and that the stretched wire comes vertically over the vines.

Length of trellises.—In order to avoid unnecessary walking and hauling, the trellises should not be too long. Cross avenues should be left at convenient distances; about every 200 to 300 feet is generally considered sufficient, and is a convenient length for stretching a wire between two posts. It is also in most cases about the best length for irrigation furrows.

MATERIALS

In choosing the materials for staking or trellising the best compromise possible should be made between quality and price. This compromise will vary with local conditions.

Posts.—Split posts are better than sawn posts if they are made of wood which splits regularly. They are stronger than sawn posts of the same size, though the latter may be used if they cost less.

Coast redwood free from sapwood is the most durable. Next to this come cedar, and big tree redwood. Pine or other woods available

in California decay too quickly. Where the best coast redwood cannot be obtained it is advisable to creosote the lower ends of the permanent posts and stakes. This is especially necessary in the warmer localities and in alkaline soils.

Stakes.—Only split stakes should be used, as they are not only much stronger but usually cheaper than sawn. Only coast redwood is satisfactory.

Pickets.—As the pickets are supported at both ends, their strength is not so important and they are more easily obtainable and better

Fig. 13.—Young vineyard trellised for cordon pruning.

if sawn. Redwood is the best for these, also, but if tarred almost any lumber will last for the three or four years necessary. Laths are too thin and pliable and will not hold the staples. Willows or saplings of almost any kind, 1 inch to 1½ inches in diameter, can be used if treated with bluestone. They are placed the day they are cut with their base in a couple of inches of a 2 to 5 per cent solution of bluestone. In a few hours they absorb enough bluestone to preserve them for two or three years. They seem to decay more quickly in soil containing alkali. Spanish bamboo (*Arundo Donax*) can also be used but must be thoroughly dried before using to prevent rooting and to kill any white ants that infest it.

Wire.—Smooth galvanized-iron fencing wire seems to be the best kind. Soft wire stretches and becomes loose.

The best sizes are No. 11, No. 12, and No. 13. No. 11 is the best for the lower wire, which supports the main weight of vine and crop. No. 13 is sufficiently strong for the upper wire.

Staples.—For holding the wire to the posts and stakes, 1½-inch galvanized fencing staples are the best, and for fastening the pickets to the wire ¾-inch staples. The pickets may also be tied to the wire with strong cord or twine, but this is less satisfactory.

COST OF MATERIAL AND LABOR

All these materials will vary in price according to the market and locality. By obtaining bids from various dealers and especially

Fig. 14.—Concrete posts used for trellising.

by ordering coöperatively in large quantities, a considerable saving can be made. It is especially advisable to order posts and stakes in carload lots in the spring, at least six months before they are needed. This enables the producer of stakes to prepare them during the summer, which is the only time he can do it economically. Stakes produced in the early summer, moreover, will have time to dry and lose weight, which results in a saving of freight charges amounting sometimes to as much as $15 per thousand.

Practically the variations in the cost of labor are much greater than in the cost of material. This depends not so much upon the rate of wages paid, as on the care with which the work is planned and on the skill and experience of the workmen.

In order to compare the cost of the various methods of staking and trellising, certain prices have been assumed for the various materials used. These prices are calculated from the average prices and freight rates quoted in 1921–22.

Materials	*Price*
Split redwood posts, 7′ × 4″ × 5″	$ .50 each
Split redwood stakes, 6′ × 2″ × 2″	80.00 per 1000
Split redwood stakes, 5′ × 2″ × 2″	70.00 per 1000
Split redwood stakes, 4′ × 2″ × 2″	54.00 per 1000
Split redwood stakes, 3′ × 1½″ × 1½″	40.00 per 1000
Sawn redwood pickets, 48″ × 1″ × 1″	13.00 per 1000
Sawn redwood pickets, 40″ × 1″ × 1″	11.00 per 1000
Sawn redwood pickets, 36″ × 1″ × 1″	10.00 per 1000
Wire, No. 11	2.00 per thousand ft.
Wire, No. 12	1.65 per thousand ft.
Wire, No. 13	1.30 per thousand ft.
Staples, 1½″, No. 9	.90 per 1000
Staples, ¾″, No. 15	.15 per 1000
Labor	.50 per hour.

By substituting for these prices any other local prices, the approximate cost can be computed for any conditions, and different methods and materials compared.

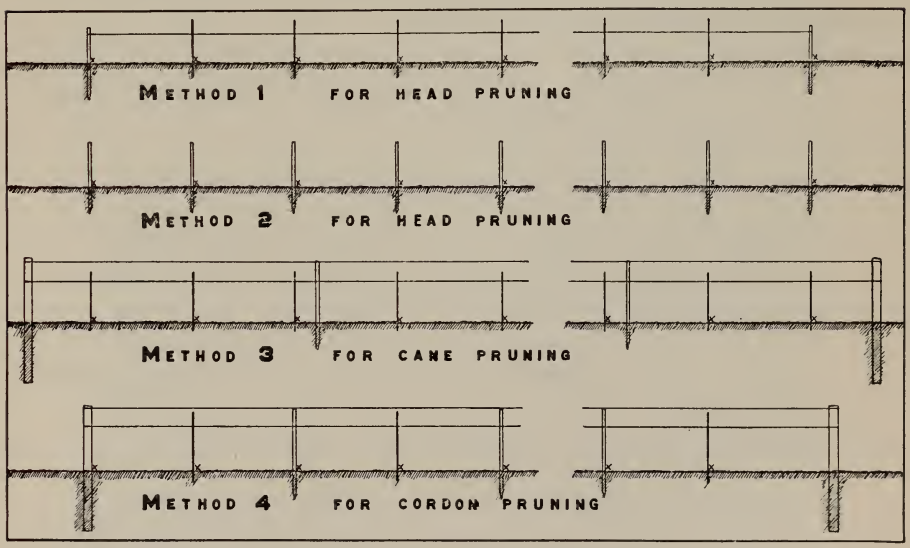


Fig. 15.—Diagram of methods.

SPECIFICATIONS

The number of vines and therefore the amount of material needed will depend on the planting distance, the area occupied by roads, avenues, turning spaces, irrigation ditches, border trees, etc. In the following calculations certain conditions are assumed regarding these matters, viz.:

1. No space is left for ditches or border trees.
2. All avenues or turning spaces are at least 15 feet wide.
3. Border spaces are at least as wide as the rows.
4. The blocks are between 200 and 250 feet wide and all of equal size.

The calculations are made for a square area of 40 acres as most representative of vineyards in California. For smaller vineyards, the amount of material used per acre would be somewhat less owing to the larger proportion of border and turning space. The cost would be about the same per acre, however, owing to the larger proportionate cost of smaller operation. For larger vineyards the amount of material per acre would not vary much and would usually be equalized by the introduction of main roads for hauling.

A. Cost of staking a 40-acre head-pruned vineyard planted 8′ × 12′. Method 1. (See fig. 15.)

Grape stakes, 4′ × 2″ × 2″	1,308	at	$54.00	$71.00	
Pickets, 40″ × 1″ × 1″	17,004	at	11.00	187.00	
Wire, No. 12	137,340	at	1.65	227.00	
Staples, 1½-inch	2,616	at	.90	3.00	
Staples, ¾-inch	17,004	at	.15	1.00	
					$489.00
Driving stakes				$40.00	
Stretching wire				138.00	
Setting and stapling pickets				102.00	
Distributing materials, etc.				100.00	
Labor					380.00
Total cost					$869.00

Cost per acre, $21.23.

B. Cost of staking a 40-acre head-pruned vineyard planted 8′ × 12′. Method 2. (See fig. 15.)

Grape stakes, 4′ × 2″ × 2″	17,004 at $54.00	$918.00	
Driving stakes		525.00	
Total cost			$1,443.00

Cost per acre, $36.08.

C. Cost of trellising a 40-acre cane-pruned vineyard planted 7′ × 14′. Method 3. (See fig. 15.)

Posts, 7′ × 4″ × 5″	930 at	$ .50	$465.00	
Grape stakes, 5′ × 2″ × 2″	5,115 at	70.00	358.00	
Pickets, 40″ × 1″ × 1″	16,275 at	11.00	179.00	
Wire, No. 11	114,000 at	2.00	228.00	
Wire, No. 13	114,000 at	1.30	148.00	
Staples, 1½″	15,000 at	.90	14.00	
Staples, ¾″	17,000 at	.15	3.00	
Materials				$1,395.00
Setting posts			$47.00	
Driving stakes and stapling			155.00	
Setting pickets and stapling			98.00	
Stretching wire			228.00	
Distributing materials, etc.			100.00	
Labor				$628.00
Total cost				$2,023.00

Cost per acre, $51.00.

D. Cost of trellising a 40-acre cordon-pruned vineyard planted 7′ × 14′. Method 4. (See fig. 15.)

Posts, 7′ × 4″ × 5″	930 at	$ .50	$465.00	
Grape stakes, 5′ × 2″ × 2″	7,905 at	70.00	554.00	
Pickets, 48″ × 1″ × 1″	7,905 at	13.00	104.00	
Wire, No. 11	114,000 at	2.00	228.00	
Wire, No. 13	114,000 at	1.30	148.00	
Staples, 1½″	21,000 at	.90	19.00	
Staples, ¾″	8,000 at	.15	2.00	
Materials				$1,520.00
Setting posts			$47.00	
Driving stakes and stapling			237.00	
Setting pickets and stapling			48.00	
Stretching wire			228.00	
Distributing materials, etc.			100.00	
Labor				660.00
Total cost				$2,180.00

Cost per acre, $54.50.